Policy note CIEF No. 02
June 16th 2021

> Endogeneity is a technical aspect that econometricians should take into account to identify causal relationships. This is particularly challenging in structural nonlinear demand systems of equations where there is censoring,we propose a Bayesian approach to perform inference in these systems.

UNIVERSIDAD EAFIT
Escuela de
Economía y Finanzas

Bayesian estimation of the EASI demand system:

Replicating the Lewbel and Pendakur (2009) results

Andrés Ramírez-Hassan

Bayesian estimation of the EASI demand system: Replicating the Lewbel and Pendakur (2009) results

Andrés Ramírez-Hassan

Department of Economics

Universidad EAFIT

Medellín, Colombia

Abstract

Endogeneity is a technical aspect that econometricians should take into account to identify causal relationships. This is particularly challenging in structural nonlinear demand systems of equations where there is censoring. In turn, these systems are very useful to analyze welfare implications due to changes in prices, for instance, associated with tax reforms. One of the most popular demand system is the exact affine Stone index (EASI) proposed by Lewbel and Pendakur (2009). We propose a Bayesian approach to perform inference in these systems. Our proposal takes into account nonlinearity and endogeneity, enables us to easily handle censored data, test and impose inequality restrictions (strict cost monotonicity) and concavity of the cost function, and perform inference of nonlinear functions of the parameter estimates as byproduct of the posterior chains.

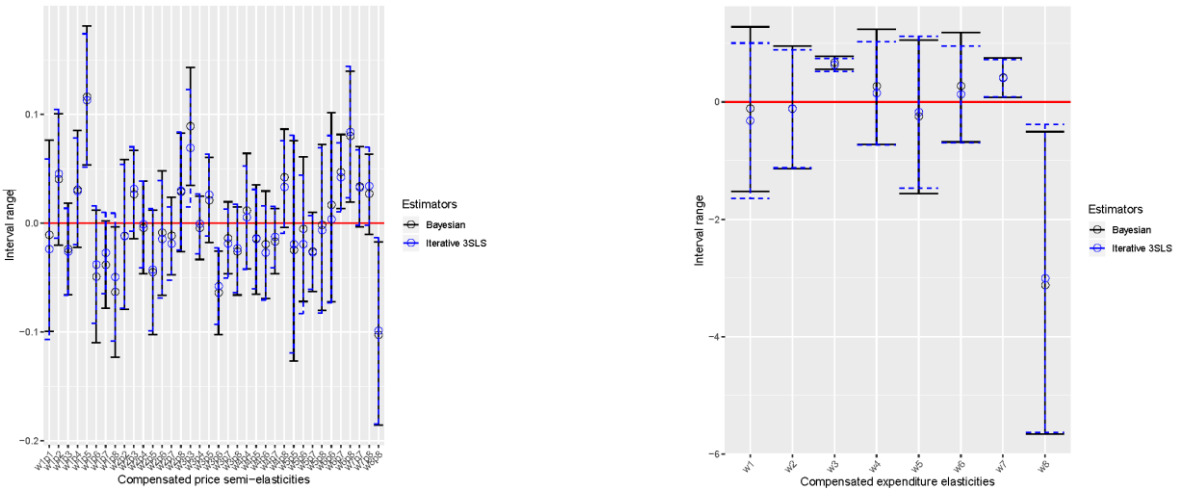
Lewbel and Pendakur (2009) proposes the exact affine Stone index (EASI) implicit Marshallian demand system to understand consumer behavior such that elasticities and welfare implications can be analyzed under a microeconomic founded framework. This is very useful to analyze implications of price changes due to firms' strategies or tax reforms.

However, it is challenging to obtain reliable parameter estimates of the EASI demand system due to technical issues such as endogeneity, nonlinearity and censoring. Lewbel and Pendakur (2009) propose the iterative three-stage least squares (3SLS) approach. However, their approach did not consider the censoring issue.

We propose to estimate the EASI demand system using a Bayesian framework. Our approach allows taking into account endogeneity, nonlinearity and censoring in systems of equations. In addition, we can easily check microeconomic restrictions such as concavity of the cost function, strict cost monotonicity and symmetry, and perform inference of nonlinear functions of the parameter estimates as byproduct of the posterior chains. Although these analyzes can be also performed using iterative 3SLS, this approach requires extra computational burden and mathematical developments.

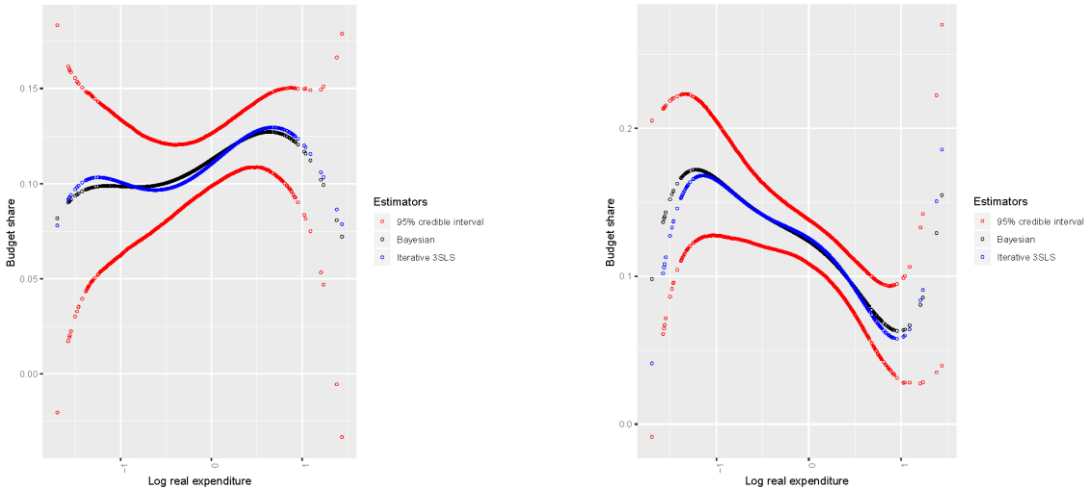
We observe that there are no statistically significant differences in the point estimates between the iterative linear 3SLS and our Bayesian proposal using Lewbel and Pendakur (2009)'s dataset (See Figure 1.). However, it seems that omitting censoring over-estimates the precision. Our Bayesian proposal has approximately 4.7% wider intervals compared to iterative linear 3SLS when using exactly the same data, whose maximum level of censoring is 9.2%. Meanwhile, our proposal has 15.8% wider intervals using a subsample with a higher level of censoring, whose maximum is equal to 25.7%.

Figure 1. EASI model: Bayesian and 3SLS.



We also calculated the Engel curves using our proposal and iterative 3SLS (see Figure 2). We observe that the Engel curves are similar. A nice advantage of our Bayesian approach is that we can calculate the credible intervals as byproduct of the posterior chains.

Figure 2. Engel curves in EASI model with excess of zeros: Bayesian and 3SLS.



Policy Note CIEF

No. 02, June 16th 2021

Universidad EAFIT

Claudia Restrepo Montoya
Rector

César E. Tamayo Tobón
Dean School of Economics and Finance

Santiago Tobón
Director of the Economic and Financial Research Center
School of Economics and Finance

UNIVERSIDAD EAFIT
Escuela de Economía y Finanzas